Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Engineering 15 (2011) 3802 – 3807

Procedia Engineering

www.elsevier.com/locate/procedia

Advanced in Control Engineering and Information Science

Development of Die Sets standard parts library based on Pro/E

QingMing Fan[a,b,]a*, Geng LIU[b], Wei Wang[b]

[a] *School of Mechatronic Engineering,Xi'an Technological University, Xi'an 710032, China*
[b] *School of Mechanical Engineering, Northwestern Polytechnical University, Xi'an 710032, China*

Abstract

The topic carries out development of die sets standard parts library according to "China Die & Mould Engineering Canon" .Parametric solid models are built based on Pro/E, the family table library of standard parts is established using the Family Table Function of Pro/E, the database library of parts is established by using Access, the Man-Machine interactive interface is designed by applying Python, the application program is developed with VC ++6.0 and Pro/Toolkit, so as to parametric die sets standard parts library system is established. The system has good man-machine interactive interface with strong features of interactive dialogue window, and it's easy for user to choose standard parts, to fetch the corresponding data from database according to the National Standard of the standard part, to build the corresponding 3D solid model of die sets standard parts automatically by the application program. The system could help user to complete the die design rapidly and improve the innovation design and efficient.

Keywords: die sets, Parametric,Pro/Toolkit, Family Table

1. Introduction

Die sets are the fundamental components of the die design. Die sets standard parts library could improve design efficiency, reduce the development circle and less the labor strength, and it's important for enterprises to standardized design. Die sets standard parts library is an important part of the CAD system, provides users with standard parts, and helps user to complete the die design rapidly by using the existing resources once they determine the design. In the current competitive environment, companies that engage in producing development and die design hope to short the design and manufacturing time. In the die design, application of die sets standard parts library could help the designers to extract 3D model of standard parts directly from the library. So, building standard parts library could liberate the designers from tedious and repetitive work, save design time and make the designers' focus on the design concept mainly to improve the innovation design and efficient.

2. Technical route

The basic technical route of establishing the die sets standard parts library is as follows:

- According to the structure of die sets, parametric 3D models of the die sets standard parts library are established based on Pro/E, structural parameters of the models and constraints between them are defined, and the models parametric drive are realized.
- According to the "China Die & Mould Engineering Canon", using the Family Table function of Pro/E, the family table library of standard parts is established.

* Corresponding author. Tel.: 15029808303.

1877-7058 © 2011 Published by Elsevier Ltd. Open access under CC BY-NC-ND license.
doi:10.1016/j.proeng.2011.08.712

- According to the "China Die & Mould Engineering Canon", the data table's library of standard parts by using Access is established, and each data table contains all parameters of each die sets standard part.
- The tree structure file which expresses the hierarchical structure of the die sets standard parts is written by XML.
- The Man-Machine interactive interface is designed by applying Python, which functions include analyzes the tree structure file to create structure tree of the die sets library, calls the parts' 2D pictures from 2D structure picture library, calls the 3D models pictures from 3D model picture library, calls geometric parameters of the part from database library, and displays these information on the interface.
- Application program is developed with VC ++6.0 and Pro/Toolkit which is the secondary development kit of Pro/E. The application program could call the Man-Machine interactive interface, fetch the corresponding data from the family table library according to the national standard of the parts chosen by the user, and build the corresponding 3D solid model of die sets of standard parts automatically. The structure of the standard parts library system is shown in Fig. 1.

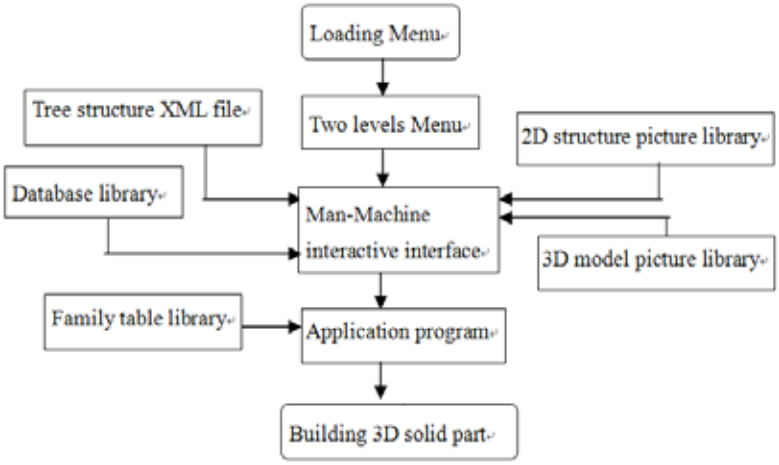

Fig.1 The structure of the die carrier standard parts library system

3. Key Technologies

3.1. Establish parametric models library

Parametric 3D models of the die sets standard parts library are the basis of this design. The 3D models should follow one uniform standard, meet the requirements of designs, and be demanded to be constrained fully by fundamental equations, and so that the 3D models could be driven to generate new 3D models by the Family Table function. The creating method of parametric 3D models is similar to general models', but the fundamental principles and attentive points should be followed are listed below when parametric 3D models of the die sets standard parts are built.

- In the process of building 3D models of the die sets standard parts, each model should have one reference datum such as datum point, datum axis or datum plane, but three mutually perpendicular datum planes are mainly used
- In the process of building 3D models of the die sets standard parts, reasonable selection of datum plane is important. Pay attention to that the size variables should be kept in contact with the datum planes. When marking dimensions on the parametric 3D models, reasonable datum planes should be selected as references, and at the same time, make the size variables as few as possible.
- The parameter variable symbols of the parametric 3D models should be maintained as far as possible consistent with the national standard, and it's easy to be identified and distinguished. At the same time, the number of parameters should be minimized.
- The 3D models should have certain heterogeneity, and the models could be driven to generate new 3D models but the topological relationship could be maintained.

- The parent-child relationship of the features should be taken fully into account. According reasonable order to build models, such as the changeless shapes features are usually established before the variegated shape features.

Fig. 2 is the 2D structure picture of the upper die seat of middle guide, which the Chinese National Standard is GB/T 2855.9-1990. Fig.3 shows the 3D model picture of the GB/T 2855.9-1990, which is built parametric solid model based on Pro/E.

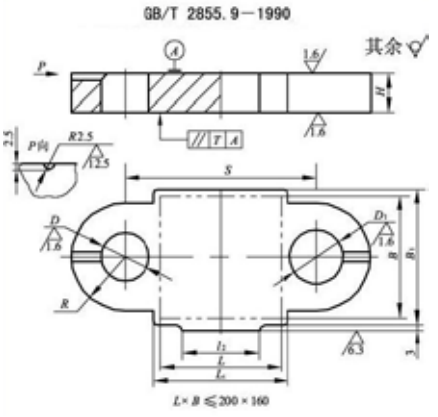

Fig. 2 2D structure picture of the GB/T 2855.9-1990

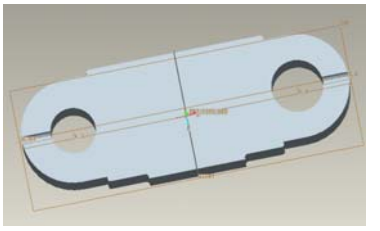

Fig. 3 3D model picture of the GB/T 2855.9-1990

3.2. Establish parametric models library

Using the Family Table function of Pro/E, it's easy to produce a series of features similar to the parametric 3D models which have built. This method is suitable for establishing a standardized library. The parametric 3D models are constrained fully by fundamental equations, and then the Family Table function could drive 3D models to generate new 3D models. The major steps to establish models' family table library are listed below.

- Modify the parameter names of the models: Selecting the desired parameters, all dimensions parameters of the models are modified based on the Chinese National Standards. Once the parameter is selected, it would be highlighted.
- Constraint the size relations of the models: Defining the relationships between the features, models and components by fundamental equations. Expressing the driving dimensions with the size symbols, and building the functional relationships between driving dimensions and driven dimensions, completing the relationships' constrains between the features, models and components.
- Establish models' family table: Using the Family Table function of Pro/E to build family tables of the models. In each family table, a new vertical line is added then a new driving dimension is added, a new horizontal line is added then a new sub-component is added. Table 1 is family table of the upper die seat of middle guide, which the Chinese National Standard is GB/T 2855.9-1990.

Table 1 Family table of the upper die seat of middle guide GB/T 2855.9-1990

Family Table :GBT2855_9-1990

File Edit Insert Tools

Look In: GBT2855_9-1990

Instance Name	d0 H	d8 L1	d7 B1	d9 S	d1 R	d4 L2	d2 D	d3 D1
GBT2855_9-1990	25	70	70	100	28	40	25	28.
GBT2855_9-1990_1	20	70	60	100	28	40	25	28
GBT2855_9-1990_2	25	70	60	100	28	40	25	28
GBT2855_9-1990_3	20	70	70	100	28	40	25	28
GBT2855_9-1990_4	25	70	70	100	28	40	25	28
GBT2855_9-1990_5	25	90	70	120	32	60	28	32
GBT2855_9-1990_6	30	90	70	120	32	60	28	32
GBT2855_9-1990_7	25	110	70	140	32	60	28	32
GBT2855_9-1990_8	30	110	70	140	32	60	28	32
GBT2855_9-1990_9	25	90	90	125	35	60	32	35

3.3. Tree structure XML file of die sets

The die sets standard parts library includes sliding guide cast iron die sets, anti-friction bearing cast iron die sets, sliding guide steel platedie sets, anti-friction bearing steel platedie sets, new standard of sliding guide die sets and new standard of anti-friction bearing die sets six categories, each category could be distributed into four or six subclasses of die sets, and each die sets contains several standard parts . Tree structure file of the die sets is written in XML based on Unicode according the above classifications to show the structure of the die sets standard parts library, and the tree structure XML file is shown in fig. 4.

```
<?xml version="1.0" encoding="utf-8"?>
<node name="Classification of the Die Sets">
    <node data="" name="sliding guide cast iron die sets">
        <node data="" name="GB/T 2851.1-1990">
        <node data="" name="GB/T 2851.3-1990">
        <node data="" name="GB/T 2851.4-1990">
        <node data="" name="GB/T 2851.5-1990">
            <node data="GBT2855_9-1990" name="GB/T 2855.9-1990"/>
            <node data="GBT2855_10-1990" name="GB/T 2855.10-1990"/>
            <node data="GBT2861_1-1990" name="GB/T 2861.1-1990"/>
            <node data="GBT2861_6-1990" name="GB/T 2861.6-1990"/>
        </node>
        <node data="" name="GB/T 2851.7-1990">
        <node data="" name="GB/T 2851.7-1990">
        <node data="" name="GB/T 2851.6-1990">
        <node data="" name="GB/T 2851.6-1990">
    </node>
    <node data="" name="anti-friction bearing cast iron die sets">
    <node data="" name="sliding guide steel plate die sets">
    <node data="" name="anti-friction bearing steel plate die sets">
    <node data="" name="new standard of sliding guide die sets (GB/T 2851-2008) ">
    <node data="" name="new standard of anti-friction bearing die sets (GB/T 2852-2008) ">
</node>
```

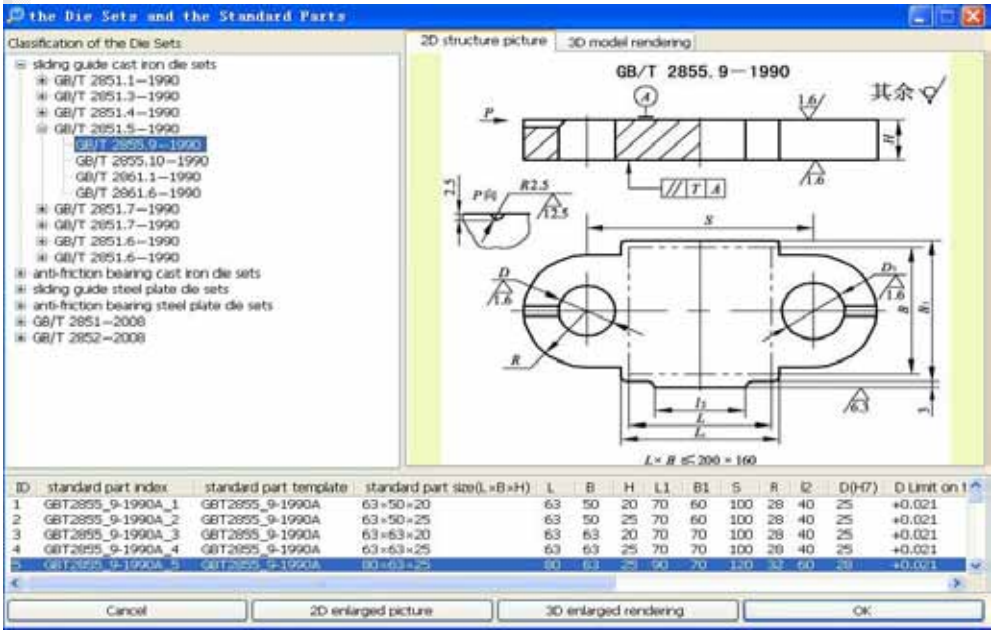

Fig. 4 Tree structure XML file of the die sets library

Fig. 5 Man-Machine interactive interface by applying Python

3.4. Man-Machine interactive interface program design

The Man-Machine interactive interface is an important part of the die sets standard parts library. The library includes tree structure of the die sets, 2D structure picture of the standard parts, 3D render model picture of the standard parts, and Access table of the standard parts， provides four buttons for user to operate and select . On the one hand, the Man-Machine interactive interface faces the users providing user-friendly search and user interface; on the other hand, it should be geared to the needs of application program to call and run the files, complete of the specified command.

The Man-Machine interactive interface is designed based on Python. its primary functions include analyzing the tree structure XML file to create structure tree of the die sets library and showing the classification of the die sets, calling the parts' 2D pictures from 2D structure picture library, calling the 3D models pictures from 3D model picture library, calling geometric parameters of the part from database, and displaying these information on the interface.

Fig. 5 is the Man-Machine interactive interface designed, which shows the tree structure on the left and the GB/T 2855.9-1990 part which is selected, shows the corresponding 2D structure picture on the right, and shows the part's geometric parameters on the below.

3.5. Design application program using VC ++6.0 and Pro/Toolkit

Application program is designed by VC ++6.0 and Pro/E Software Development Kit (Pro/TOOLKIT), which can access control Pro/E safely and be integrated with Pro/E by automatic registration method. As shown in Fig. 6, it shows that the application program has been integrated with Pro/E. The Man-Machine interactive interface could be called by clicking the secondary menu. Selecting any one set of geometric parameters of the part on the interface, the corresponding new 3D solid of the standard part is built automatically by the application program, which fetches the corresponding part from models' family table library according to gauge of the National Standard. Fig.7 is the fifth 3D model of GB/T 2855.9-1990 which is selected in Fig. 5

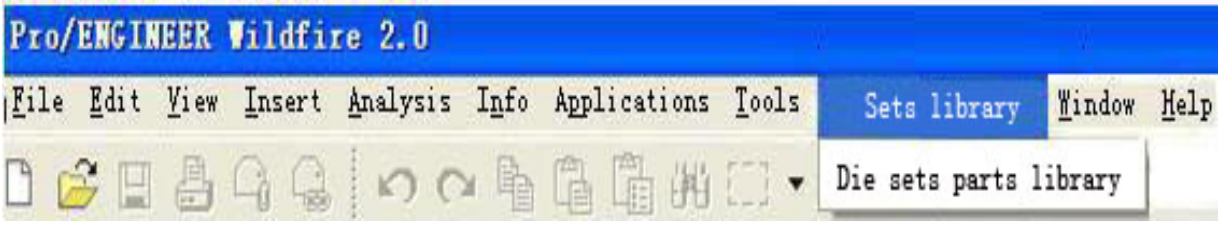

Fig. 6 The interface of the Application program integrate with Pro/E

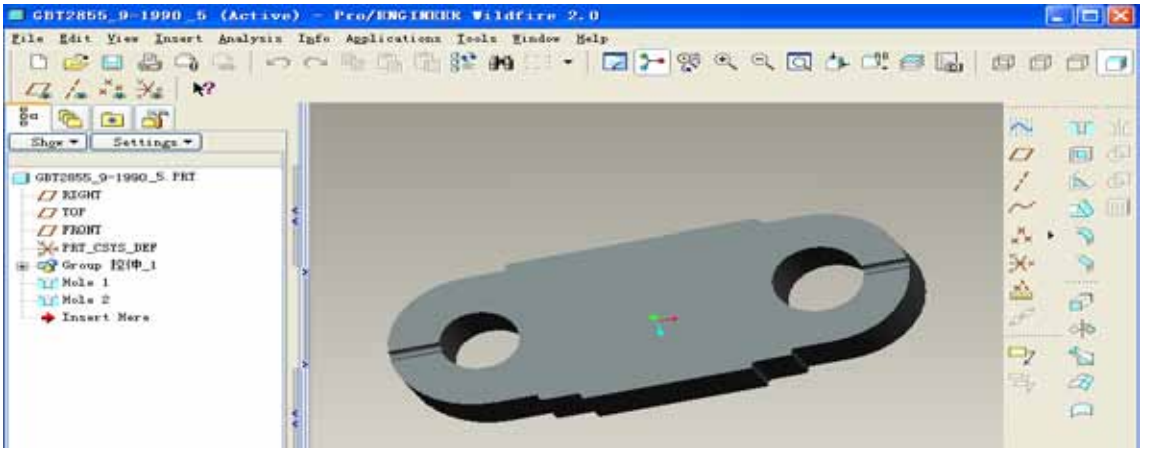

Fig. 7 The fifth 3D model of GB/T 2855.9-1990

4. Conclusion

Die carrier standard parts library allows designers to query different types and different specifications standard parts easily through the tree structure, to retrieve 2D structure picture and 3D model picture and parameter data information, to get three-dimensional model directly. The Man-Machine interactive interface designed is simple, elegant, and easy to operate. The Die carrier standard parts library could save time greatly and improve throughout design efficiency.

Acknowledgements

The research work is supported by Shaanxi Major Subject Construction Project, President Fund of Xi'an Technological University (XGYXJJ0414), and Shaanxi Provincial Programs for Technology Research and Development under Grant No.2010K01-076, namely "The Research and Application of Digital Manufacturing Execution System" .

References

[1]Xiao Xiangzhi, Wang Xiaopei. China Die & Mould Engineering Canon. Beijing: Electronic Industry Press,2007.

[2]WU Yi-zhong,XU Hua,WANG Qi-fu.Study and Implementation of a 3D Standard-Part Library System Based on Component Object Model. Mechanical Science and Technology, 2004, 1.

[3] Parametric Technology Corporation. Pro/TOOLKIT User Guide Manual. USA: Published by PTC,1998.

[4]Mark Lutz, David Ascber. Learning Python. China Electric Power Press,2001

[5]Fabio Arciniegas. XML Developer's Guide. Tsinghua University press,2003